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Compactor

Background of the Invention

This invention relates to a compector which is based on the use of impact rollers.

The term "impact roller" was used by the applicant in 1953 in U.S. patent 2,909,106 end in equivalent patent applications in other countries to describe a non-circular impact mass which when towed over a surface by means of an appropriately constructed drawbar and tractive vehicle delivers a series of impact blows. The shaped mass i.e. the roller, In all prior impact rolling machines of which the applicant is aware, is relatively narrow, of the order of $1\frac{1}{2}$ meters wide, and is surrounded by the frame of a drawbar.

The relatively narrow Impact rollers of the type described have been drawn by a towing vehicle, and suffer from the particular disadvantage that the roller Is considerably narrower than the track width of the towing vehicle, and consequently it cannot compact the full width traversed by the vehicle. Consequently when work is done on earth embankments a zone of uncompacted soil which is usually more than e meter wide Is left elong the embankment edge. This soil must then be compacted by other means.

Conventional rollers are of generally circular profile and may have projecting formations such as sheeps feet, as is known from, for example, US patent 1 931 766. The action of a conventional roller Is a pure rolling motion.

In conventional roller technology it is known to locate two rollers side by side in order to extend the width of the zone rolled on each traverse. Such machines are described, in, for example. US patents 1,931,766 and 2,911,893. Each roller is rotatable independently of the other, to facilitate yawing and similar manoeuvres. However the teachings of such conventional roller technology, do not apply to impact rollers.

If two impact rollers located side by side are left to rotate independently, the rapid changes in the momentum of the impact rollers as they advance leads to jerky and irregular movement, and the tractor drawing these impact rollers tends to be whipped about. If on the other hand the impact rollers are joined firmly to a stiff shaft and thus made to rotate entirely synchronously (a solution which is not customary in conventional roller machines) the shaft is subjected to very large stresses which tend to cause the shaft to snap.

Summary of the Invention

Is is an object of the present invention to provide a compactor which enables this disadvantage to be remedied.

The invention provides an impact compactor comprising a chassis adapted to be drawn by a tractive device, axle means connected to the chassis, and an impact roller of non-circular profile supported on the axle means for traction by the chassis and rotation relatively to the chassis, characterised by a second impact roller of substantially identical non-circular profile supported on axle means for similar traction and rotation, torsionally resilient means being provided to ensure that the two impact rollers rotate substantially in synchronism with each other but permitting a degree of out-of-synchronism movement In response to torsional forces.

In one form of the Invention there is provided an impact compactor having axle means including a set of bearings at each end, and a shaft mounted in the bearings, the shaft being torsionally resilient end having an impact roller fixed to it at each end.

The torsionally resilient means may include deformable elements located between securing means that hold the impact rollers on the axle means.

Another form of the invention provides a compactor having axle means including two axles on each of which an impact roller is rotatably supported, and including torsionally resilient means interconnecting the two impact rollers. Each axle may comprise a tubular member supporting a set of bearings on which is mounted an impact roller, and the means interconnecting the impact roller may comprise a torsionally resilient shaft located In the bores of the tubular members, the two impact rollers being each secured to an end of the shaft.

Such a compactor may include for each of the impact rollers retaining means which prevents disengagement of the Impact roller from the end of the shaft on failure of the axle on which thet impact roller is supported. In addition this compactor may include for each of the two impact rollers further retaining means which prevents disengagements of the impact roller from the axle on which that impact roller is mounted on failure of the torsionally resilient shaft.

Preferably each impact roller of a compactor according to the invention includes a hub element which is located substantially in the plane containing the centre of gravity of the impact roller and which is secured to a supporting structure associated with the axle meens. Deformable elements may be located between the hub element and the supporting structure.

The effectiveness of the compactor in compacting the edges of earth embankments may be improved through the use of a skirt which is releasably secured to the outer side of one of the impact rollers, the skirt having an embankment-forming surface which extends outwardly and away from the impact surface of the impact roller.

The compactor may further include ground-engaging wheels which are located between the impact rollers, the ground-engaging wheels being mounted on the chassis, which is drawn by a tractive device. When the tractive device performs a sideways movement, the chassis induces the axle means and the impact rollers also to turn sideways with a yawing motion. The ground-engaging wheels of the trolley will, during this yawing motion, have a degree of sideways slip relatively to the ground surface, the degree of sideways slip being minimised when the wheels are placed in a position directly under the axle means which connects the pair of impact rollers.

Brief Description of the Drawings

The invention is further described by way of examples with reference to the accompanying drawings in which:

Figure 1 is a schematic side view of a compactor according to a first form of the invention;

Figure 2 is a plan view of the compactor of Figure 1, partly sectioned;

Figure 3 is an enlarged view of an alternative form of a hub assembly for the compactor of Figures 1 and 2;

Figure 4 is e schematic side view of a compactor according to a second form of the invention; and

Figure 5 is a partly sectioned plan view of the compactor of Figure 4.

Description of Preferred Embodiments

In Figures 1 to 3, a compactor includes a chassis 10 which has two ground-engaging wheels 12 and 14 respectively and which at its forward end includes a mechanism, not shown, whereby it may be coupled to a tractive device e.g. a tractor. The wheels 12 and 14 are of course not driven, and are rotatable independently of each other. They support the weight of the chassis 10.

A linkage system 16, 17, 20, 22 connects the chassis 10 to an axle means 18. The axle means comprises a tube 24 to which the linkage members 20, 22 are attached and a shaft 26 rotatably supported inside the tube 24 by means of bearings 28.

The opposed ends of the shaft 26 extend from the tube 24. Each shaft end is tapered and has a keyway 30 in which is engaged a key 32. The key in turn is engaged with a keyway in a hub 34 which is retained on the shaft end by means of a nut 36.

The hub 34 forms part of a hub mechanism, designated generally by the reference numeral 38, of an impact roller 40 which has four impact surfaces. The hub 34 has a first flange 35 which overlaps with a second flange 42 which is fixed to the impact roller 40 and which lies in the plane containing the centre of gravity of the impact roller 40. In Figure 2 the two flanges are illustrated as being directly bolted to one another, whereas in the inventive embodiment shown in Figure 3, the two flanges 35 and 42 are secured to each other by means of bolts 44 which pass through rubber grommets 46 and rubber washers 48.

In use traction is exerted on the compactor via the chassis 10. The traction is applied via the linkage system 16, 17, 20, 22. The linkages 16, 17 are so constructed as to be strong in torsion thereby enabling lateral steering forces to be transmitted to the linkages 20, 22 and thence to the axle tube 24, the shaft 26, and the impact rollers 40.

The shaft 26 constrains the impact rollers to rotate in unison i.e. in synchronism with one another. Bending forces which are exerted through the impact rollers on the shaft 26 during operation are reduced to a minimum in thet the shaft is supported on the bearings 28 which are located close to the line of application of the impact force i.e. in the plane of the second flange 42. Bending forces on the shaft are also minimized in that the flange 42 is located in the plane of the centre of gravity of the impact roller 40 and consequently the mass of the roller does not in itself give rise to undue stresses in the shaft.

A further reduction in stresses is achieved by means of the resilient grommets 46 and washers 48 in the hub assembly 38. These grommets and washers permit a degree of resilient tilting of each impact roller relatively to the shaft (and consequently to the axle means) and so prevent excessive shock loads from being transmitted between the first flange 35 and the second flange 42 i.e. between the impact rollers and the axle means.

The lateral spacing of the impact rollers 40 which is clearly evident from Figure 2 means that the compaction zones on the surface on which the compactor is operated extend outside the path which is treversed by the tractive device. Consequently the rollers are able to compact the edges of earth embankments. The effectiveness of the compaction may be increased yet further by means of a compacting skirt 50 as illustrated in Figure 2. The skirt 50 has a compacting i.e. embankment forming surface 52 which extends outwardly and away from the impact surface 54 of the impact roller 40. The skirt is releasably secured to the outer side of the impact roller by means of bolts 56. The surface 52 of the skirt forms an angle 58 with the horizontal which is the desired angle of slope of the embankment.

Figures 1 and 2 schematically illustrate a springing device 60 which interconnects the linkage system 16, 17, 20 22 and the chassis 10. The Figures do not purport to show the type of springing device used in practice. The device 60 may be any suitable mechanism e.g. a spring combined with damping, and is used to create an elastic traction force while at the same time cushioning shock loadings arising in operation of the compactor between the axle means and the chassis 10.

The embodiment of the compactor shown in Figures 4 and 5 is equally effective for use in compacting embankments but, as with the former compactor, this compactor's use is not restricted to applications of this type. The compactor includes two laterally separated five sided impact rollers 70 and 72 respectively which are rotatably supported on a chassis 74. A drawbar 76 which forms part of the chassis 74 is used to apply tractive effort to the compactor. Use may be made of a springing mechanism 78, illustrated schematically in the drawings, to provide springing and damping of forces between the compactor and the tractor or other tractive device.

The chassis 74 in this embodiment includes a tubular member 80 the ends of which are stopped to form two stub axles 82. Each stub axle has bearings 84 which rotatably support a hub 86 of the respective impact roller 70. A retaining plate 88 is bolted to the end of the stub axle 82 and prevents the hub 86 from moving axially off the stub axle 82.

A shaft 90 is located inside the tubular member 80. The shaft is freely rotatable relatively to the tubular member and its ends extend beyond the ends of the stub axle 82. Each shaft end has a keyway 92 in which is located a key 94. An outer flanged hub 96 which has a complementary keyway 98 is engaged with the key 94 and is bolted to the hub 86. The shaft end extends through the outer hub 96 and a retaining plate 100 is secured to the shaft end by means of a nut 102.

The design of the compactor is such that the tubular member 80 and the stub axles 82, can withstand the bending moments which are imposed on them by the movement of the two impact rollers 70 and 72. The tubular member 80 is not employed to enforce synchronous rotation of the impact rollers for, in the absence of the shaft 90, the impact rollers are rotatable on their respective stub axles independently of one another.

The shaft 90 is employed to transmit torsional forces between the impact rollers and to ensure that they rotate in synchronism. Since the shaft is secured by means of keys to each impact roller the only relative rotational movement permissible between the rollers is that offered by the torsional resilience of the shaft 90.

In this embodiment of the invention, as in the former embodiment, the hub assembly of each impact roller is such that the roller is supported on the axle means substantially in the plane of its centre of gravity. Consequently bending stresses are minimized.

The retaining plates 88 and 100 respectively enhance the safety of the compactor. If the stub axle 82 should fail the retaining plate 100 maintains the coupling of the respective impact roller to the shaft and so prevents the impact roller from becoming detached from the axle means and proceeding on an uncontrolled path. On the other hand if the shaft 90 should fail the retaining plate 88 ensures that the respective impact roller is held captive on the axle means.

With the embodiment of the invention shown in Figures 4 and 5 use could again be made, instead of the chassis 74, of a wheeled chassis 10 of the type shown in Figures 1 and 2. Similarly, resilient bodies should be employed in the coupling between the hub 86 and the rim 104 of the impact roller 70 to permit limited movement of the impact rollers relatively to the axle means in response to bending forces. Clearly a skirt 50 of the type shown in Figure 2 could be employed with the second embodiment of the invention.

In each embodiment of the invention a compactor is provided which is capable of compacting surface areas located outside the pathway travelled by a tractive vehicle. This feature makes the compactor particularly suitable for use in compacting the edges of embankments. Moreover because of the spacing of the impact rollers the compactor is inherently more stable and so is able to operate on steep sites.

Claims

1. An impact compactor comprising a chassis (10; 76) adapted to be drawn by a tractive device, axle means (18; 74) connected to the chassis, and an impact roller (40; 70) of non-circular profile supported on the axle means for traction by the chassis and rotation relatively to the chassis, characterised by a second impact roller (40; 72) of substantially identical non-circular profile supported on axle means (18; 74) for similar traction and rotation, torsionally resilient means (26; 46, 48; 92) being provided to ensure that the two impact rollers rotate substantially in synchronism with each other but permitting a degree of out-of-synchronism movement in response to torsional forces.

2. An impact compactor according to claim 1, characterised in that the axle means (18) includes a tubular member (24) supporting a set of bearings (28) at each end, and a shaft (26) mounted in the bearings, the shaft (26) being torsionally resilient and having an impact roller (40) fixed to it at each end.

3. An impact compactor according to claim 1 or claim 2, characterised in that the torsionally resilient means includes deformable elements (46, 48) located between securing means (34, 44, 42) that hold the impact rollers (40) on the axle means (18).

4. A compactor according to claim 1, characterised in that the axle means (74) includes two axles (82) on each of which an impact roller is rotatably supported, and including torsionally resilient means (90) interconnecting the two impact rollers.

5. A compactor according to claim 4, characterised in that each axle (82) comprises a tubular member (80) supporting a set of

bearings (84) on which is mounted an impact roller (70, 72), and the means interconnecting the impact roller comprises a torsionally resilient shaft (90) located in the bores of the tubular members, the two impact rollers being each secured to an end of the shaft.

6. A compactor according to claim 5, characterised in that it includes for each of the impact rollers a first retaining means (100) which prevents disengagement of the impact roller (70) from the end of the shaft (90) on failure of the axle (82) on which that impact roller is supported.

7. A compactor according to claim 5 or 6, characterised in that it includes for each of the two impact rollers a second retaining means (88) which prevents disengagement of the impact roller (70) from the axle (82) on which that impact roller is mounted on failure of the torsionally resilient shaft (90).

8. a compactor according to any one of claims 1 to 7, characterised in that each impact roller includes a hub element (42) which is located substantially in the plane containing the centre of gravity of the impact roller (40) and which is secured to a supporting structure (34) associated with the axle means (18).

9. A compactor according to claim 8, characterised in that deformable elements (46, 48) are located between the hub element (42) and the supporting structure (34).

10. A compactor according to any one of claims 1 to 7, characterised in that each impact roller (70, 72) includes a hub (86) located substantially centrally with respect to the plane containing the centre of gravity of the impact roller, and mounted in two bearings (84) that are located on opposite sides of such plane.

11. A compactor according to any one of claims 1 to 10, characterised in that it includes a skirt (50) which is releasably secured to the outer side of one of the impact rollers (40), the skirt having an embankment-forming surface (52) which extends outwardly and away from the impact surface (54) of the impact roller.

12. A compactor according to any one of claims 1 to 11, characterised in that the chassis (10) is provided with ground-engaging wheels (12, 14) which are located between the impact rollers (40).

13. A compactor according to claim 12, characterised in that the ground-engaging wheels (12, 14) are capable of supporting the weight of the impact rollers (40) and means is provided to lift the impact rollers on the chassis (10) above the level of the ground.

14. A compactor according to any one of claims 1 to 13, characterised in that the chassis (10; 76) and axle means (18, 74) terminate inwardly of the outboard edges of the impact rollers (40; 70, 72).

Revendications

1. Compacteur à impact comportant un châssis (10, 76) adapté à la traction par un dispositif tracteur, un système d'essieu (18, 74) relié au châssis, et un rouleau à impacts (40, 70) de profil non circulaire monté sur le système d'essieu pour permettre la traction par le châssis et la rotation par rapport au châssis, caractérisé par le fait qu'un second rouleau à impacts (40, 72) de profil non circulaire sensiblement identique est monté sur le système d'essieu (18, 24) pour permettre une traction et une rotation similaires, et que des moyens élastiques en torsion (26, 46, 48, 92) sont disposés pour assurer une rotation des deux rouleaux à impacts sensiblement en synchronisme l'un par rapport à l'autre tout en permettant en réponse aux efforts de torsion un certain degré de décalage par rapport au synchronisme.

2. Compacteur à impacts selon la revendication 1, caractérisé par le fait que le système d'essieu (18) comporte un élément tubulaire (24) supportant un jeu de paliers (28) à chaque extrémité, et un arbre (26) monté sur le paliers, l'arbre 26 étant élastique en torsion et ayant un rouleau à impacts (40) fixé à chacune de ses extrémités.

3. Compacteur à impacts selon l'une des revendication 1 ou 2, caractérisé par le fait que les moyens élastiques en torsion incluent des éléments déformables (46, 48) situés entre des éléments de fixation (34, 44, 42) qui maintiennent les rouleaux à impacts (40) sur le système d'essieu (18).

4. Compacteur selon la revendication 1, caractérisé par le fait que le système d'essieu (74) comporte deux pivots d'essieu (82) sur chacun desquels un rouleau à impacts est monté rotatif, ce compacteur comportant en outre des moyens élastiques en torsion (90) reliant les deux rouleaux à impacts.

5. Compacteur selon la revendication 4, caractérisé par le fait que chaque pivot d'essieu (82) comporte un élément tubulaire (80) supportant un jeu de paliers (84) sur lequel est monté un rouleau à impacts (70, 72) et que les moyens reliant les rouleaux à impacts comportent un arbre élastique en torsion (90) situé dans les évidements des éléments tubulaires, les deux rouleaux à impacts étant chacun fixé à une extrémité de l'arbre.

6. Compacteur selon la revendication 5, caractérisé par le fait qu'il comporte pour chacun des rouleaux à impacts, un premier système de retenue (100) qui empêche le rouleau à impacts (70) de se dégager de l'extrémité de l'arbre (90) en cas de rupture du pivot (82) sur lequel le rouleau à impacts est monté.

7. Compacteur selon la revendication 5 ou 6, caractérisé par le fait qu'il inclue pour chacun des deux rouleaux à impacts un second système de retenue (88) qui empêche le rouleau à impacts (70) de se dégager du pivot (82) sur lequel est monté le rouleau à impacts en cas de rupture de l'arbre élastique en torsion (90).

8. Compacteur selon l'une quelconque des

revendications 1 à 7, caractérisé par le fait que chaque rouleau à impacts comporte un élément de moyeu (42) qui est situé sensiblement dans le plan contenant le centre de gravité du rouleau à impacts (40) et qui est fixé à la structure de support (34) associée au système d'essieu (18).

9. Compacteur selon la revendication 8, caractérisé par le fait que des éléments déformables (46, 48) sont montés entre l'élément de moyeu (42) et la structure de support (34).

10. Compacteur selon l'une quelconque des revendications 1 à 7, caractérisé par le fait que chaque rouleau à impacts (70, 72) comporte un moyeu (86) situé dans une position sensiblement centrale par rapport au plan contenant le centre de gravité du rouleau à impacts et monté dans deux paliers (84) qui sont situés sur les côtés opposés de ce plan.

11. Compacteur selon l'une quelconque des revendications 1 à 10, caractérisé par le fait qu'il comporte une jupe (50) qui est fixée d'une manière amovible sur la face extérieure d'un des rouleaux à impacts (40), la jupe possédant une surface (52) de mise en forme de remblai qui s'étend vers l'extérieur et en s'éloignant de la surface d'impact (54) du rouleau à impacts.

12. Compacteur selon l'une quelconque des revendications 1 à 11, caractérisé par le fait que le châssis (10) est muni de roues s'engageant dans le sol (12, 14), ces roues étant situées entre les rouleaux à impacts (40).

13. Compacteur selon la revendication 12, caractérisé par le fait que les roues s'engageant dans le sol (12, 14) sont capables de supporter le poids des rouleaux à impacts (40) et que des moyens sont disposés pour soulever les rouleaux à impacts sur le châssis (10) au-dessus du niveau du sol.

14. Compacteur selon l'une quelconque des revendications 1 à 13, caractérisé par le fait que le châssis (10, 76) et le système d'essieu (18, 74) se terminent en deçà des bords externes des rouleaux à impacts (40, 70, 72).

Patentansprüche

1. Stoßverdichter, mit einem von einer Zugvorrichtung ziehbaren Chassis (10:76), mit an das Chassis angeschlossenen Achsmitteln (18:74) und mit einer von den Achsmitteln getragenen und so vom Chassis ziehbaren und relativ zum Chassis drehbaren Stoßwalze (40:70) mit nicht-kreisförmigem Querschnitt, gekennzeichnet durch eine von Achsmitteln (18:74) für ähnliche Zug- und Drehbewegungen getragene zweite Stoßwalze (40:72) mit im wesentlichen identischem nichtkreisförmigem Querschnitt und durch torsionsmäßig federnde Federmittel (26; 46, 48; 92), wobei vermittels der Federmittel die beiden Stoßwalzen zwar im wesentlichen synchron miteinander rotieren, jedoch ein bestimmtes Maß an asynchronen Bewegungen aufgrund von Torsionskräften möglich ist.

2. Stoßverdichter nach Anspruch 1, dadurch gekennzeichnet, daß die Achsmittel (18) ein an jedem Ende einen Satz von Lagern (28) tragendes röhrenförmiges Element (24) und einen in den Lagern (28) befestigten Schaft (26) aufweisen, daß der Schaft (26) torsionsmäßig federnd ausgebildet ist und daß an jedem Ende des Schaftes eine Stoßwalze (40) befestigt ist.

3. Stoßverdichter nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die torsionsmäßig federnden Federmittel zwischen die Stoßwalzen (40) an den Achsmitteln (18) haltenden Befestigungsmitteln (34, 44, 42) angeordnete verformbare Elemente (46, 48) aufweisen.

4. Verdichter nach Anspruch 1, dadurch gekennzeichnet, daß die Achsmittel (74) zwei, jeweils eine Stoßwalze drehbar tragende Achsen (82) und die beiden Stoßwalzen verbindende torsionsmäßig federnde Federmittel (90) aufweisen.

5. Verdichter nach Anspruch 4, dadurch gekennzeichnet, daß jede Achse (82) ein röhrenförmiges Element (80) aufweist, das röhrenförmige Element (80) einen Satz von Lagern (84) trägt und auf dem Satz von Lagern (84) eine Stoßwalze (70, 72) befestigt ist und daß die die Stoßwalzen verbindenden Mittel einen torsionsmäßig federnden Schaft (90) aufweisen, der Schaft in den Bohrungen der röhrenförmigen Elemente angeordnet ist und die beiden Stoßwalzen jeweils an einem Ende des Schaftes befestigt sind.

6. Verdichter nach Anspruch 5, dadurch gekennzeichnet, daß für jede der Stoßwalzen erste Haltemittel (100) vorgesehen sind und daß diese Haltemittel auch bei Ausfall der die Stoßwalze tragenden Achse (82) ein Lösen der Stoßwalze (70) von dem Ende des Schaftes (90) verhindern.

7. Verdichter nach Anspruch 5 oder 6, dadurch gekennzeichnet, daß für jede der beiden Stoßwalzen zwelte Haltemittel (88) vorgesehen sind und daß diese Haltemittel auch bei Ausfall des torsionsmäßig federnden Schaftes (90) ein Lösen der Stoßwalze von der die Stoßwalze tragenden Achse (82) verhindern.

8. Verdichter nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß jede Stoßwalze ein im wesentlichen in der den Schwerpunkt der Stoßwalze (40) enthaltenden Ebene angeordnetes Nabenelement (42) aufweist und daß das Nabenelement an eine den Achsmitteln (18) zugeordnete Tragkonstruktion (34) angeschlossen ist.

9. Verdichter nach Anspruch 8, dadurch gekennzeichnet, daß die verformbare-Elemente (46, 48) zwischen dem Nabenelement (42) und der Tragkonstruktion (34) angeordnet sind.

10. Verdichter nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß jede Stoßwalze (70, 72) ein im wesentlichen mittig bezüglich der den Schwerpunkt der Stoßwalze enthaltenden Ebene angeordnetes Nabenelement (86) umfaßt und daß das Nabenelement (86) in

zwei auf gegenüberliegenden Seiten dieser Ebene angeordneten Lagern (84) gelagert ist.

11. Verdichter nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, daß eine an der Außenseite der Stoßwalzen (40) abnehmbar befestigte Schürze (50) vorgesehen ist und daß die Schürze eine sich nach außen und weg von einer Stoßfläche (54) der Stoßwalze erstreckende absatzbildende Fläche (52) aufweist.

12. Verdichter nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet, daß das Chassis (10) zwischen den Stoßwalzen (40) angeordnete Bodentragräder (12, 14) aufweist.

13. Verdichter nach Anspruch 12, dadurch gekennzeichnet, daß die Bodentragräder (12, 14) zur Aufnahme des Gewichts der Stoßwalzen (40) geeignet sind und daß Hubmittel vorgesehen sind, um die Stoßwalzen am Chassis (10) vom Boden abzuheben.

14. Verdichter nach einem der Ansprüche 1 bis 13, dadurch gekennzeichnet, daß das Chassis (10; 76) und die Achsmittel (18, 74) innerhalb der äußeren Begrenzungskanten der Stoßwalzen (40; 70, 72) enden.

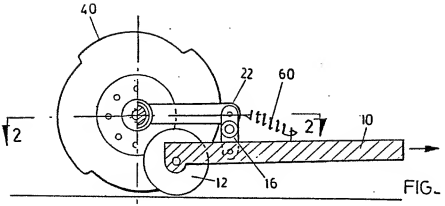

FIG. 1

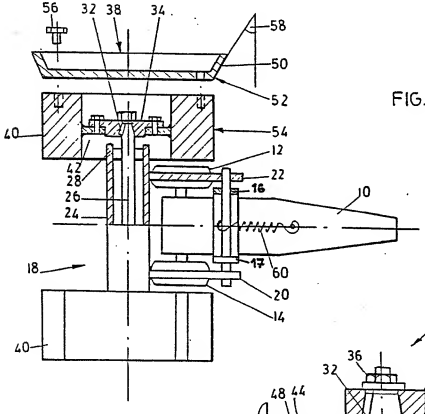

FIG. 2

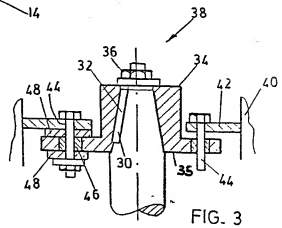

FIG. 3

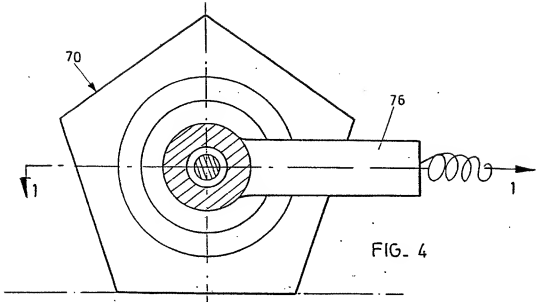

FIG. 4

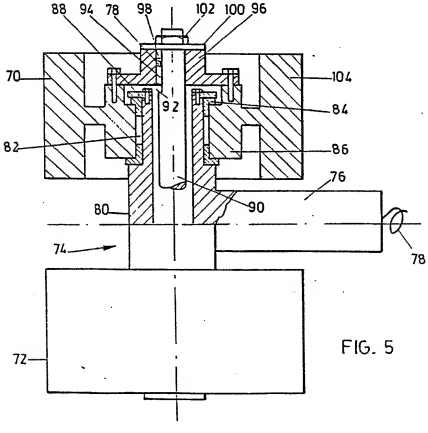

FIG. 5